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Research Paper

Examining Dependence of Mathematical Anxiety and Peer Pressure on Mathematical Achievement of Secondary School Students

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ABSTRACT

There are many psychological factors like psychological capital, peer pressure, intelligence, mathematical anxiety, motivation, concentration, and academic stress on which mathematical achievement of secondary school students may depend. Among these, mathematical anxiety is an important factor which can badly affect the students' performance in mathematics. Peer pressure can also influence the mathematical achievement of a student positively or negatively. In the present study, we have studied the effect of mathematical anxiety and peer pressure on the mathematical achievement of secondary school students. The statistical analysis has been performed by calculating the means, standard deviations, t-values and F-ratios. The comparison and analysis have been made on the basis of gender and demographic area. Upon analysis, significant differences between mathematical achievement, mathematical anxiety and peer pressure of male and female as well as rural and urban secondary school students have been observed. Analyzing F-ratios, it is found that a particular combination of Gender and Demographic area has a significant interaction effect on mathematical achievement, mathematical anxiety and peer pressure of secondary school students. The study is quite useful for determining the various factors to improve the mathematical achievement of secondary school students.

Keywords: *Mathematical Achievement, Mathematical Anxiety, Peer Pressure*

Mathematics knowledge is vital for profitable achievement in all academic fields. It acts as the global language and an effective means of communication and offers a solid foundation for comprehending and resolving problems in a variety of fields. The Government of India placed a strong emphasis on the value of mathematics education at several levels in its National Policy on Education (NPE) of 1986. It also emphasizes the importance of mathematics in building analytical and critical thinking skills in the students. Furthermore, it highlights the value of mathematics education as a fundamental part of the curriculum, even though it does not state clearly that all students must take mathematics throughout their first ten years of education.

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The mathematical achievement is the measure of proficiency of a person in handling the mathematical problems and skills. It can be evaluated by using standardized tests, quizes or by designing problem solving tasks. Van den Aardweg (1988) stated that achievement is a product that can be quantified using achievement tests and is associated with mental success. Ranjeeta and Agnihotri (2015) conducted a comparative study of learning and thinking styles, and academic achievement of secondary school students in smart schools and government schools. The findings showed that the students from smart schools and government schools do not differ in their learning and thinking styles, but differ in their academic achievement. Barroso et al. (2021) studied and analyzed the relationship between math anxiety and math achievement, using data from studies conducted between 1992 and 2018. The authors found a small-to-moderate negative correlation between math anxiety and math achievement. Ran et al. (2022) conducted a meta-analysis of the impact of technology on mathematics instruction and its effect on student's mathematical achievement. The study establishes that technology has a minor but positive effect on student achievement in mathematics.

The term "Mathematical anxiety" implies the feeling of apprehension, fear, or stress that arises when dealing with mathematical tasks or situations. Mathematical anxiety can stem from various factors, including past negative experiences with math, fear of failure or making mistakes, pressure to perform well, or a lack of confidence in one's mathematical abilities. Olson (1985) studied the causes and correlation of mathematics anxiety and the mathematics achievement. Mathematics achievement, mathematics attitude, field independence and anxiety measures were found to be significant predictors of the level of mathematics anxiety. Swars (2006) investigated the relationship between mathematics anxiety and mathematics teacher efficacy among elementary pre-service teachers. The pre-service teachers having lower mathematics anxiety possess higher mathematics teacher efficacy. Salahot (2022) investigated the impact of Mathematics Anxiety on Mathematics Performance among Secondary School Students in Tanzania because of consistent trends of abysmal mathematics performance in the country. Their results indicated a significant impact of Mathematics Anxiety on Mathematics Performance among secondary school students.

Peer pressure refers to the influence that peers or members of one's social group exert on an individual to conform to certain behaviors, attitudes, or norms. Peers are the friends of the same age as classmates who might impact a student's moral growth, personality formation, and behavior. Peer pressure can manifest in various forms, such as encouragement to participate in certain activities, adopt particular fashion trends, conform to group norms, or engage in risky behaviors. It can be positive, encouraging individuals to engage in constructive activities or behaviors, but it can also be negative, leading to conformity to harmful or undesirable behaviors. The Oxford Advanced Learners Dictionary (2016) defines, "a peer group as a group of people of the same age or social status". This group is the first social group outside the home environment in which the children learn to get appreciation and respect.

Bojuwoye and Mbanjwa (2006) conducted a study to explore all the factors that have a strong influence on career decisions. It was found that the factors like the certain occupational status, performance in examinations, influence of teachers, peer pressure and studied subjects mainly decide the careers of the students. Sangeetha and Chetan (2015) studied the relationship between happiness and peer pressure among adolescents. The results

showed that there was a negative correlation between happiness and peer pressure among adolescents. Inguglia et al. (2019) analyzed the relationship between peer pressure and binge behavior in adolescents and revealed a significant and positive relationship between peer pressure and binge behavior. Zhang (2023) investigated how peer pressure affects students' participation in web-based peer learning (WPL). Peer pressure was observed to arise gradually during WPL, influenced by both technology and non-technological variables, and ultimately positively benefited the students, albeit it might also exert negative force.

The literature review shows that mathematical achievement is influenced by different elements such as mathematical anxiety and peer pressure. In the present study, we plan to conduct a statistical analysis of the mathematical achievement of secondary school students in relation to their mathematical anxiety and peer pressure. The analysis based on gender and demographic area including rural and urban schools is primarily focused.

Objectives

The following objectives were set to examine the relationship between mathematical achievement and mathematical anxiety.

- To compare the mathematical achievement, mathematical anxiety and peer pressure of male and female secondary school students.
- To compare the mathematical achievement, mathematical anxiety and peer pressure of rural and urban secondary school students.
- To study the interaction effect of (i) gender and (ii) demographic area on mathematical achievement, mathematical anxiety and peer pressure of secondary school students.

Hypotheses

- **H_{01}** There exists no significant difference in mathematical achievement of male and female secondary school students.
- **H_{02}** There exists no significant difference in mathematical anxiety of male and female secondary school students.
- **H_{03}** There exists no significant difference in peer pressure of male and female secondary school students.
- **H_{04}** There exists no significant difference in mathematical achievement of rural and urban secondary school students.
- **H_{05}** There exists no significant difference in mathematical anxiety of rural and urban secondary school students.
- **H_{06}** There exists no significant difference in peer pressure of rural and urban secondary school students.
- **H_{07}** There exists no interaction effect of (i) gender and (ii) demographic area on mathematical achievement of secondary school students.
- **H_{08}** There exists no interaction effect of (i) gender and (ii) demographic area on mathematical anxiety of secondary school students.
- **H_{09}** There exists no interaction effect of (i) gender and (ii) demographic area on peer pressure of secondary school students.

Research Design

To find out the difference of mathematical achievement, mathematical anxiety and peer pressure of (i) male and female, and (ii) rural and urban secondary school students, and to

check the interaction effect of gender and demographic area on mathematical achievement, mathematical anxiety, and peer pressure of these students, the means, standard deviations, t-values and F-ratios were calculated and compared in the study. The factorial design was employed to study the relationship between two or more independent variables operating simultaneously.

Identification and selection of students for study

To collect the data for the present study, we selected 32 schools from four districts of Haryana state (Hisar, Jhajjar, Kaithal and Yamunanagar). We have used a simple random sampling method for their selection. From these schools, a total of 600 students have taken part in the investigation. The mathematics achievement test, Mathematical Anxiety Scale, and Peer Pressure Scale were administered to this sample and the output was segregated into two different groups, (i) male and female and (ii) rural and urban schools.

Instrumentation

The three instruments were used to collect data from the respondents. These are as follows:

(i) **Mathematics Achievement Test (MAT)** was developed by the investigators (Rani and Rani (2023)). It was made from half of the NCERT syllabus of mathematics of Class X. For each right/wrong question, one/zero mark was awarded to the respondent. It has 50 multiple-choice questions of equal marks. The maximum score on this test was 50.

(ii) **Mathematical Anxiety Scale** was developed by Mahmood and Khatoon (2012). Questions included in Mathematical Anxiety Scale (MAS) are intended to identify the bi-dimensional effects, positive (e.g. liking, excitement, pleasant, comfortable) and negative (e.g. fear, dread, nervousness, worry) toward mathematics. The MAS contains 25 items on a 5-point Likert scale.

(iii) **Peer Pressure Scale** was developed by Singh and Saini (2010). It is a uni-dimensional scale that gives an estimate of peer pressure in adolescents. This scale consists of 25 items. The total score of an individual respondent was varied from 25 to 125. It is a self-report 5-point Likert-type scale.

Statistical Technique

The following statistical techniques were used to analyze the data:
(i) Mean, (ii) Standard Deviation, (iii) T-test and (iv) F-ratio

RESULTS AND DISCUSSION

In order to study the comparison of mathematical achievement, mathematical anxiety, and peer pressure of secondary school students based on **gender/demographic area (**objective 1/2), the null hypothesis $\mathbf{H_{01}}$-$\mathbf{H_{03}}$ / $\mathbf{H_{04}}$-$\mathbf{H_{06}}$ were formulated. For testing the corresponding null hypothesis, the mean standard deviation and t-values of the scores obtained from the mathematics achievement test, mathematical anxiety scale, and peer pressure scale of secondary school students were calculated. The corresponding results are listed in Table 1 and Table 2 for gender and demographic area based analysis, respectively.

Table 1: Mean, Standard Derivation (SD), Standard Error Deviation (SED) and t-values of Mathematical Achievement, Mathematical Anxiety and Peer Pressure of male and female secondary school students

Dependent Variables	Groups	N	Mean	SD	SED	t-value
Mathematical achievement	Male	300	28.86	11.27	0.871	4.388**
	Female	300	25.03	10.04		
Mathematical Anxiety	Male	300	46.78	13.79	0.927	-4.095**
	Female	300	50.57	8.17		
Peer Pressure	Male	300	83.97	23.60	1.731	3.154**
	Female	300	78.51	18.50		

**Significant at 0.05 level of significance (table value = 1.97 at df =592)*
***Significant at 0.01 level of significance (table value = 2.59 at df =592)*

Table 2: Mean, Standard Derivation (SD), SED and t-values of Mathematical Achievement, Mathematical Anxiety and Peer Pressure of rural and urban secondary school students

Dependent Variables	Groups	N	Mean	SD	SED	t-value
Mathematical Achievement	Rural	300	24.87	10.84	0.869	-4.157**
	Urban	300	29.02	10.44		
Mathematical Anxiety	Rural	300	56.54	6.91	0.683	15.743**
	Urban	300	40.80	9.60		
Peer Pressure	Rural	300	94.27	17.03	1.382	26.107**
	Urban	300	68.20	16.82		

**Significant at 0.05 level of significance (table value = 1.97 at df =592)*
***Significant at 0.01 level of significance (table value = 2.59 at df =592)*

It is clear from Table 1 that the calculated t-value (4.388) for mathematical achievement is greater than the table values i.e. 2.59 at 0.01 level of significance. Thus, the null hypothesis $\mathbf{H_{01}}$ stands rejected. Hence, male and female students have different mathematical achievements. Further, the magnitude of t-value (-4.095) for mathematical anxiety is found to be more than the table value i.e. 2.59 at 0.01 level. So, the null hypothesis $\mathbf{H_{02}}$ stands rejected. The male and female students differ in mathematical anxiety. Lastly, the t-value (3.154) for peer pressure is also greater than the table value of 2.59 at 0.01 level. So, the null hypothesis $\mathbf{H_{03}}$ stands rejected. Hence, male and female students differ in terms of peer pressure.

Table 2 shows that the magnitude of calculated t-value (-4.157) for mathematical achievement is greater than the table value i.e. 2.53 at 0.01 level of significance. Thus, the null hypothesis $\mathbf{H_{04}}$ stands rejected. Hence, rural and urban senior secondary school students have different mathematical achievements. Further, the t-value (15.743) for mathematical anxiety is found to be more than the table value i.e. 2.59 at 0.01 level. So, the null hypothesis $\mathbf{H_{05}}$ stands rejected. The rural and urban students don't differ in mathematical anxiety. Lastly, the t-value (26.107) for peer pressure is greater than the table value of 2.59 at 0.01 level. So, the null hypothesis, $\mathbf{H_{06}}$ stands rejected. Hence, rural and urban students differ in terms of peer pressure. The mean values of these variables for the students based on gender/demographic area are plotted in Fig. 1/2 for comparison.

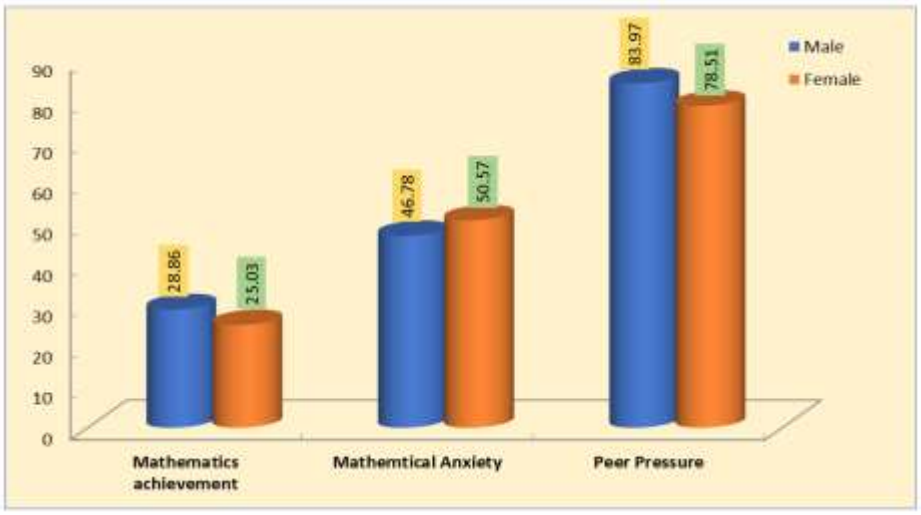

Fig. 1: Mean Scores for Mathematical Achievement, Mathematical Anxiety and Peer Pressure of secondary school students based on gender

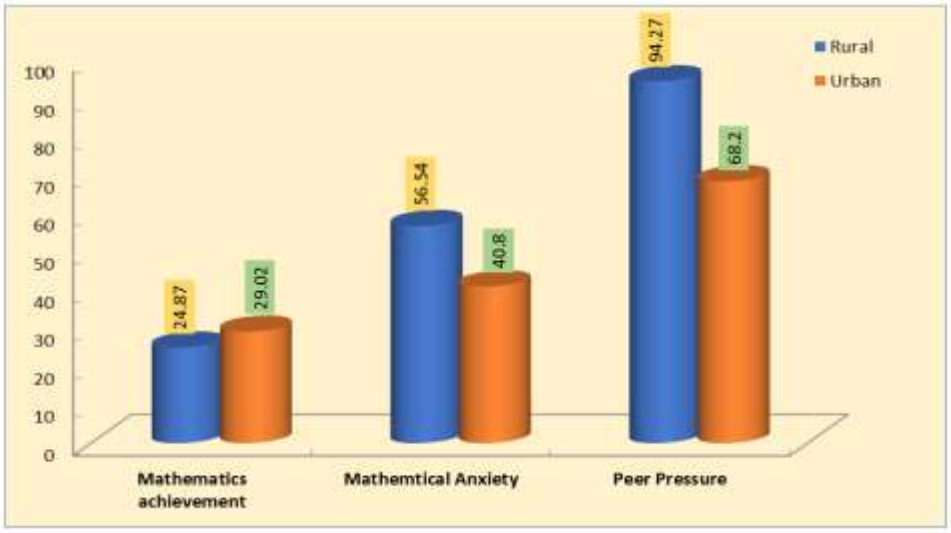

Fig. 2: Mean Scores for Mathematical Achievement, Mathematical Anxiety and Peer Pressure of secondary school students based on demographic area

Interactional Analysis

The results of two-way interaction (Gender × Demographic Area) on Mathematical Achievement, Mathematical Anxiety and Peer Pressure of secondary school students are shown in Table 3.

Table 3: Analysis of Variance for Mathematical Achievement, Mathematical Anxiety and Peer Pressure of secondary school students

Gender × Demographic area	**Sum of Squares**	**Df**	**Mean Squares**	**F-Ratio**
Mathematical Achievement	3586.815	1	3586.815	34.855**
Mathematical Anxiety	10275.482	1	10275.482	239.284**
Peer Pressure	4664.827	1	4664.827	17.370**

Table value of F-Ratio at 0.01 level is 6.69 and at 0.05 level is 3.86 for df 1/592
**Significant at 0.05 level of significance, **Significant at 0.01 level of significance.*

Table 3 reveals that the interaction effect of Gender and Demographic area for mathematical achievement is significant as the calculated value of F = 34.855 is greater than the table value, i.e. 6.69 at 0.01 level of significance. Thus, the hypothesis (**H_{07}**) "There exists no interaction effect of (i) gender and (ii) demographic area on mathematical achievement of secondary school students" stands REJECTED. Secondly, the interaction effect of Gender and Demographic area is significant as the calculated value of F = 239.284 is greater than the table value (6.69) at 0.01 level of significance. Therefore, the hypothesis (**H_{08}**) "There exists no interaction effect of (i) gender and (ii) demographic area on mathematical anxiety of secondary school students" stands REJECTED. On the other hand, the interaction effect of Gender and Demographic area for peer pressure is significant as the calculated value of F = 17.370 is more than the table value, i.e. 3.86 at 0.05 level of significance. Thus, the hypothesis (**H_{08}**) "There exists no interaction effect of (i) gender and (ii) demographic area on peer pressure of secondary school students" stands REJECTED. In the nutshell, a particular combination of Gender and Demographic area has a significant effect on mathematical achievement, mathematical anxiety and peer pressure of secondary school students. The significant factor differences in means on mathematical achievement, mathematical anxiety and peer pressure are further probed through t-test. The t-values for particular combination group (Gender × Demographic area) have been reported in Table 4.

Table 4: Mean, Standard Deviation (S.D.), Standard error of difference (SED) and t-value of particular combinations group (Gender × Demographic Area) of secondary school students on Mathematical Achievement, Mathematical Anxiety and Peer Pressure

Gender × Demographic Area	Group	N	Mean	S.D.	SED	t-value
Mathematical Achievement	Male Rural	150	24.33	11.63	1.193	-7.583**
	Male Urban	150	33.38	8.85		
	Female Rural	150	25.40	9.99	1.161	0.632
	Female Urban	150	24.67	10.12		
	Male Rural	150	24.33	11.63	1.252	-0.852
	Female Rural	150	25.40	9.99		
	Male Urban	150	33.38	8.85	1.097	7.940**
	Female Urban	150	24.67	10.12		
Mathematical Anxiety	Male Rural	150	58.79	5.63	0.780	30.783**
	Male Urban	150	34.77	7.69		
	Female Rural	150	54.30	7.31	0.840	8.888**
	Female Urban	150	46.83	7.24		
	Male Rural	150	58.79	5.63	0.756	5.937**
	Female Rural	150	54.30	7.24		
	Male Urban	150	34.77	7.69	0.862	-13.994**
	Female Urban	150	46.83	7.24		
Peer Pressure	Male Rural	150	99.77	15.56	2.024	15.621**
	Male Urban	150	68.16	19.30		
	Female Rural	150	88.77	16.71	1.779	11.536**
	Female Urban	150	68.25	13.98		
	Male Rural	150	99.77	15.56	1.864	5.905**
	Female Rural	150	88.77	16.71		
	Male Urban	150	68.16	19.30	1.946	-0.045
	Female Urban	150	68.25	13.98		

**Significant at 0.05 level of significance (table value = 1.97 at df =298)*
***Significant at 0.01 level of significance (table value = 2.59 at df =298)*

From Table 4, it is clear that there is a significant difference between rural male and urban male secondary school students on mathematical achievement as the magnitude of t-value (-7.583) is greater than the table value (2.59) at 0.01 level of significance at df = 298. It infers that urban male students have higher mathematical achievement than rural male students. On the basis of lower t-value (0.632), it is found that there exists no significant difference between rural female students and urban female students on mathematical achievement. Further, it is observed that there exist no significant difference between rural male and rural female students on mathematical achievement as magnitude of t-value for this combination comes out to be -0.852 which is lesser than 1.97 (table value) at 0.05 level of significance. Finally, there exists a significant difference between mathematical achievement of urban male and urban female students as the t-value 7.940 is significant at 0.01 level of significance (table value = 2.59 at df =298). This shows that urban male students have more mathematical achievement than urban female students.

It is also clear from Table 4 that there is a significant difference between rural male and rural male students on mathematical anxiety as the t-value 30.783 is greater than the table value (2.59) at 0.01 level of significance at df=298. It infers that rural male students have more mathematical anxiety than that of urban male students. On the basis of lower t-value (8.888), it is found that there exists a significant difference between rural female students and urban female students on mathematical anxiety. Further, it is observed that there exists a significant difference between rural male and rural female students on mathematical anxiety as t-value is 5.937 > 2.59 at 0.01 level of significance. Further, there exists no significant difference between mathematical anxiety of urban male and urban female students as the magnitude of t-value (-13.994) is more than the table value i.e. 2.59 at 0.01 level of significance. This shows that urban male students have lesser mathematical anxiety than that of urban female students.

Further, Table 4 also indicates that there is a significant difference between rural male and urban male students on peer pressure as the t-value (15.621) is greater than the table value (2.59) at 0.01 level of significance at df=298. It infers that rural male students have higher peer pressure than urban male students. On the basis of lower t-value (11.536), it is found that there exists a significant difference between rural female students and urban female students on peer pressure. Further, it is observed that there exists a significant difference between rural male and rural female students on peer pressure as t-value for this combination comes out to be 5.905 which is greater than 2.59 (table value) at 0.01 level of significance. Finally, there exists a significant difference between peer pressure of urban male and urban female students as the magnitude of t-value, (-0.045) is not significant at 0.05 level of significance (table value = 1.97 at df =298). This shows that urban male students and urban female students have similar peer pressure.

CONCLUSION AND FUTURE IMPLICATIONS

The present findings give valuable insights into the dependence of mathematical anxiety and peer pressure on mathematical achievement and analyze the performance in mathematics of secondary school students. Based on gender, it is concluded that male and female secondary school students have different mathematical achievement, mathematical anxiety and peer pressure. Thus, the understanding level of mathematics of male and female students is different such that the mathematical achievement of female students is smaller as compared to that of male students. The mathematical achievement of female students can be increased by motivation from teachers and parents, providing them equal opportunities similar to male

students. The mathematical anxiety of female students is more than that of male students. This may be due to the fact that female students sometimes are not capable of developing logical thinking and mathematical understanding. This can be reduced if parents show faith in female wards and give them more freedom to study. The peer pressure of male students is more than that of female students. The competition level among male students is more and sometimes they get affected negatively due to this. With the help of parents, teachers and counsellors, male students can cope with this negative peer pressure and perform better in mathematics. Similarly, based on demographic area, it is observed that rural and urban senior secondary school students also have different mathematical achievement, mathematical anxiety and peer pressure. The rural students have lower mathematical achievement, higher mathematical anxiety and higher peer pressure than that of urban students. The lower mathematical achievement for rural students may be due to the lack of guidance and deficiency of school teachers in rural areas. Further, if mathematics understanding level is low, then mathematical anxiety emerges out as high. The previous background of mathematical understanding, financial weakness of family and competition level generate more peer pressure among rural students which results in low mathematical achievement. All these factors can be made favorable to rural students by providing them quality education and a similar environment of study as expected in urban areas. Using F-ratios, it is found that a particular combination of Gender and Demographic area has significant interaction effect on mathematical achievement, mathematical anxiety and peer pressure of secondary school students. The outcome of present work will be helpful to gain an understanding of the various factors that influence mathematical achievement of secondary school students and will contribute to the development of new effective educational strategies to improve mathematical achievement.

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Conflict of Interest

The author(s) declared no conflict of interest.

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